What Is Patent Quality? A Merchant Banc's Perspective

By James E. Malackowski and Jonathan A. Barney

I. Introduction

The question "What is Patent Quality?" is one that has long been answered not by the authors of this paper but by the marketplace itself. It has been defined by the actions of patent holders in their decisions to maintain patents of quality and abandon patents of lesser quality and value. Ownership of quality patents has been rewarded by both public and private markets with a scale and precision that simply has not been well understood. Our statistical research shows not only that the marketplace appreciates quality patent assets, but that many of the attributes which drive quality assessment by market participants are well correlated to those that affect investor returns.

The purpose of this paper is first to shed light on the activities of the relevant marketplace to help inform public policy debate among lawmakers attempting to solve problems that may or may not exist—or at least may not exist as perceived. Second, we will put forth our argument that patent quality has not diminished and demonstrate the statistical analysis supporting this conclusion. Finally, we will share our unique perspective as an active investor in patents as an asset class—as an Intellectual Capital Merchant Banc® firm—and discuss briefly certain market observations that confirm our statistically developed views of patent quality and value.

This paper is focused on activities in the United States. The authors have begun similar analyses in both Europe and Japan and expect to report results in 2008.

II. What Is Patent Quality?

Like beauty, patent quality is often believed to be in the eye of the beholder. If you are a patent owner, the concept of patent quality will be strongly flavored in terms of claim breadth relative to a commercially valuable technology—the broader the claims and the more valuable the underlying technology, the better. If you are a manufacturer or service provider in a patent-laden technology space, the concept of patent quality takes on stronger overtones of underlying validity concerns (should this patent have been granted?) and clarity and predictability of claim scope interpretation (what are the metes and bounds of this patent? how do I avoid infringing this patent?). With significant production capital at risk, manufacturers and service providers are acutely aware of the costly pitfalls of patent infringement and understandably desire to minimize these risks by raising patent standards (making it more difficult to obtain and enforce patents) while shrinking claim breadth and the associated penumbra of uncertainty surrounding claim scope interpretation.

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An interesting twist in all this is that many patent holders are also manufacturers of underlying patented products and technologies and so the concept of patent quality can often take on a myriad of blended viewpoints, from the opposing extremes described above, to anywhere in between. In a particularly contorted example of diverging viewpoints on this topic, computer technology giant IBM (an obvious beneficiary of the patent system, receiving more U.S. patents than any other company in the world for many years running) and other 'big-tech' companies like Microsoft, Computer Associates, Adobe, Cisco, HP, Intel and Apple, have (almost counter-intuitively, it would seem) lobbied heavily in support of pending legislation that would generally make patents harder to get and easier to challenge. Sitting on the other side of the fence are 'big-pharma' giants like Pfizer, Eli Lilly, Bristol-Myers Squibb, AstraZeneca, GlaxoSmithKline, and Merck (also obvious beneficiaries of the patent system) who have fought equally arduously to defeat or curtail proposed legislative reforms they perceive as weakening the rights of patent holders.

The rather stark difference in perspective is more than a philosophical difference of opinion, but stems from fundamentally differing economic implications of patenting activities within each industry. Technology giants like IBM and Microsoft amass extensive, often sprawling patent portfolios, not so much for the purpose of creating product monopolies, but to help gain operational freedom in crowded technol-

ogy spaces clogged with existing patents owned primarily by other large competitors. Patents are used extensively as a form of 'negotiating currency' to help extract favorable licensing and cross-licensing terms from other competitors.

But an increasing number of big-tech companies have felt the sting of patent litigation brought by non-competitors, namely small patent holding companies, individuals and so-called Patent Licensing and Enforcement Companies ("P-LECs") often referred to pejoratively as 'trolls.' These patent holders, for the most part, have no interest in striking cross-license deals, but instead are focused on obtaining royalty payments or big cash damage awards from deep-pocketed defendants. A recent string of high-profile patent litigation cases resulting in record damage awards—some approaching and exceeding a billion dollars—has fanned the flames of the patent quality debate even higher.[1] The prospect of suffering continuing or even escalating financial pain under the current patent regime has motivated many folks on the big-tech side of the fence to lobby for and rally around various new legislative proposals designed to sharply pull back on the reins of the patent system and the legal rights of patent holders.[2]

Big-pharma companies (along with many independent inventors, university licensing departments and other smaller companies) have not exactly rallied to support the current proposed legislative reform measures and most would not likely characterize the proposed legislation as 'reform' in the positive improvement sense of the word. In contrast to big-tech, most big-pharma companies do not engage in extensive cross-licensing of patents, but rely heavily on patent protection to maintain monopoly pricing or near-monopoly pricing on their commercially successful drugs. Discovering and qualifying innovative new drugs is a high-risk enterprise requiring massive capital outlays which occur far in advance of potential product commercialization. Sunk costs are capitalized and recouped on the backs of a relatively small fraction of drugs that actually pass their clinical trials, are approved by the FDA, and become commercially successful products.

Because of these risks and heavy upfront investments, big-pharma companies rely extensively on strong patent protection to extract extraordinarily high profit margins from a relatively small number of patented drug products. As a result, big-pharma has not taken a favorable view toward various proposed legislative changes that would make patents even harder to obtain and enforce and easier to challenge and invalidate. Again, patent quality is defined according to the perspective of the beholder.

III. The Quality Debate

In one sense, the debate over patent quality is really a political debate concerning fundamental issues of public patent policy. The ultimate point of the debate is whether and how to readjust the balance of private interests (limited monopoly rights secured to inventors) and public interests (encouraging disclosure of new ideas in exchange for granting limited monopoly rights) in a way that perhaps more optimally "promotes the Progress of Science and useful Arts…" as directed by Article 8 of the U.S. Constitution. But much of the political debate is squarely framed within the context of perceived patent quality problems, and so it seems appropriate to address it specifically within that context.[3]

Within the spectrum of the patent quality debate there are at least two recurring themes that seem to drive the discussion and the growing calls for reform. The first broad theme centers on the concept of an overburdened patent office that is understaffed and ill-equipped to maintain pace with burgeoning new technologies and a perceived flood of new patent filings. This argument is usually heralded by a shocking, if not amusing, parade of patent horribles—bogus, dubious or outright wacky patents—which are offered up as evidence of a patent system run amuck. A particular parade favorite these days is the now infamous 'peanut-butter and jelly sandwich' patent (U.S. Pat. No. 6,004,596). A more apt theme, addressed later on below, argues that the patentability standards and/or applications of the patentability standards by the Patent Office are too low, resulting in the proliferation of many dubious patents on little more than trivial improvements.

A. Overburdened Patent Office

In substance, the first argument maintains that the Patent Office's capacity and ability to process new

1. This is more of a 'kick the dog' reaction since the patents that were involved in those high-profile litigation cases obviously survived whatever legal and/or technical challenges were mounted against them.

2. Patent Reform Act of 2007, House bill H.R. 1908 (2007) and corresponding Senate bill S. 1145 (2007). The House bill was passed on Sept. 7th, 2007.

3. Maintaining high patent quality is obviously important to ensure that applicable public patent policies are being faithfully carried out, that patents are validly granted and that the public is able to reasonably rely on the work of the patent office.

patent applications has become overtaxed and overwhelmed to such an extent that it has now reached a level of crises. Faced with limited resources and overwhelming demand for patents, the argument goes, the Patent Office is simply no longer able to maintain adequate quality controls on its examination processes, resulting in the issuance of many 'poor quality' patents (queue up the patent parade). In support of this argument are the frequently cited anecdotal problems including: long prosecution delays; inadequate prior art searching (especially outside of the U.S. patent literature); and allowance of patents with overly broad claims.

This by now familiar rhetoric and anecdotal evidence seems logical enough, even compelling at times. But, several key underlying numerical and statistical trends simply do not support the asserted conclusion that the Patent Office is overburdened or that quality of U.S. patent examination is flagging. In fact, some of the statistical evidence we have analyzed seems to suggest that patent examination quality has either remained steady or has even improved somewhat over the past five years.

Beginning with the parade of patent horribles, it should be readily apparent that selecting a few wacky patents out of literally hundreds of thousands granted annually is hardly compelling evidence of a patent system 'run amuck.' Wacky patents are not a new phenomena. In fact, they have been a delightful source of chuckles for many patent attorneys, agents, and examiners over many decades if not centuries. There are plenty of wacky patents dating back to the early 19th and 20th centuries, many no more compelling than hats with spinning propellers. Truth be told, the vast majority of such patents do not cover anything of economic value anyway and so they are simply abandoned and go away after a few years by a process of natural attrition (discussed in more detail later on). The few that do survive, and by whatever fluke actually cover something of economic value can (assuming they were erroneously granted in the first place) be easily challenged and defeated either in court or at the Patent Office. Wacky patents are not the problem. In any event, they cannot fairly be taken as statistically representative of the broader population of patents granted by the Patent Office each year.

As for pendency delays, it is certainly fair to point out that average patent pendency times have risen steadily from a low of about 1.7 years in the early 1990s to an average of about 3.4 years presently.[4] It is also fair to point out that long pendency periods are generally undesirable in an efficiently operating patent system because they delay the onset of patent protection, thereby depriving the inventor or patent holder of the full benefit of her limited patent monopoly and reducing incentives to create and disclose new ideas. The negative effects of long pendency delays are particularly pronounced in rapidly evolving technology areas where obsolescence rates can reach as high as 20 percent or 30 percent per year and technology (and product) half-lives can be as short as 3-4 years. But long patent pendency delays, while undesirable from an efficiency standpoint, do not necessarily translate into a 'broken' patent system.

Patent filing rates naturally ebb and flow with overall economic expansion and contraction cycles as well as other sporadic events and spurts of innovative activity affecting specific industries and underlying technologies. Over the past five years U.S. patent filing rates grew at an average annual rate of about 6.4 percent, reaching a peak of about 9.5 percent growth in 2005 and moderating back down to about 7.1 percent growth in 2007.[5] The average growth rate in patent filings over the previous five years is actually lower than the average growth rate over the previous ten years (about 7.9 percent) and is only slightly higher than the average growth rate over the previous 20 years (about 6.7 percent).

The most recent peak of 9.5 percent growth in patent filings experienced in 2005 may, at first blush, seem alarmingly high. But it is not unique or even particularly extraordinary when viewed from a historical perspective. Over the past 40 years annual growth in patent filing rates reached similar peaks in 1968 (9.1 percent), 1988-1989 (averaging 9.3 percent), 1995 (11.9 percent) and 1997-2001 (averaging 10.8 percent). Viewed within this proper historical context, the recent surge in the rate of patent filings is nary a blip in the road. Whatever implications can ultimately be drawn from the latest surge of activity, it can hardly be characterized as an overwhelming flood of crisis proportions as frequently described by some in the patent reform camp.

Of course, the rate and direction of new technol-

4. Based on the average pendency (from filing date to issuance date) of approximately 46,000 U.S. utility patents issued in the 1st quarter of 2008. This pendency calculation is slightly different than published pendency figures from the U.S. Patent Office which measure the average time from filing date to either patent issuance or abandonment.

5. Filing rates of U.S. utility patent applications based on annual filing statistics published by the U.S. Patent Office.

ogy innovations are not always predictable. This may lead to occasional shortages in patent examination resources as hiring and training of new examiners in surging technology areas lags peak demand. Longer pendency delays are the natural result of this process. But, again, it does not necessarily mean the system is broken. In fact, a growing backlog of cases under peak usage conditions is the expected and desired result of a patent examination system that is maintaining standards and quality controls at steady levels. While exceedingly long pendency delays would be a fair cause for concern, the current average pendency of 3.4 years is comparable to those found in other major patent offices around the world.[6] It is also not without precedent in the U.S. For example, in 1952—another period of rapid economic and technological development—average patent pendency reached over 3.6 years. Increasing pendency delays are probably more fairly characterized as an indication of a growing patent system than a broken patent system.

Inadequate prior art searching (especially outside of the U.S. patent literature) is another frequently raised anecdotal facet of the overburdened-patent-office argument. Examiners, the argument goes, being highly pressed for time and resources, do not have adequate opportunity to conduct sufficiently thorough prior art searches. Examiners also are often said to lack latest generation search tools and specialized databases particularly adapted for searching and identifying relevant non-patent prior art. Again, several key underlying numerical and statistical trends simply do not support these conclusions.

As can be gleaned from Table 1 below, U.S. utility patents issued in 2007 actually cited significantly more prior art, on average, than patents issued five years ago, including 41 percent more U.S. patent documents, 36 percent more foreign patent documents, and 23 percent more non-patent documents.

Table 1: Utility Patents Issued

Year	U.S. Refs	Foreign	NonPat
2007	18.95	4.04	4.10
2006	17.78	3.67	4.04
2005	15.61	3.30	3.78
2004	14.09	2.95	3.39
2003	13.40	2.98	3.34

While this significant growth in prior art citations may not be conclusive evidence of increased search thoroughness or search quality, it is certainly suggestive evidence and is plainly inconsistent with the notion that search thoroughness and search quality have somehow declined in recent years. Even common sense tells us that the most ubiquitously available search tools today (e.g. Google®) can access references that a decade ago would have remained undiscovered. The statistical data appears consistent with the conclusion that examination search thoroughness and search quality is as good or better today than it was five years ago.

Examiners granting patents with overly broad claims is another commonly cited anecdotal factor in support of the flagging quality and overburdened-patent-office argument. But, statistical analysis of the underlying numerical data suggests otherwise—that examiners, on average, are granting patents with slightly more narrow claims than they were five years ago. While claim breadth cannot be precisely measured mechanically or statistically, counting the average number of words per independent claim in an issued patent can serve as rough proxy if taken from a sufficiently large, statistically relevant sample.[7] That is because each word in a claim introduces a further legal limitation upon its scope.

In this case, we find that patents issued in 2007 had an average word count per independent claim of 160.1. This reflects approximately a 4.4 percent increase over the average per claim word count of 153.3 among patents issued in 2003.[8] As a point of reference, applications published in 2007 contained an average per independent claim word count of 111.1, indicating a substantially broader claim-scope 'ask' relative to what the Patent Office ultimately granted—patent examiners requiring 42.1 additional limiting words, on average. This latter statistic is roughly

6. See, P. Jensen, et al., *Application Pendency Times and Outcomes Across Four Patent Offices*, Intellectual Property Research Institute of Australia, Working Paper No. 01/08ISSN 1447-2317 February 2008 (reporting average patent pendency times of 14 months for the Australian Patent Office, 42.7 months for the European Patent Office and 34 months for the Japanese Patent Office based on a sample matched set of patents filed during the period from 1990 to 1995).

7. More sophisticated measurements could also be applied (e.g., counting the number of different words in each claim, filtering words according to frequency of use, and weighting words according to frequency of use) but these measurements introduce additional complexities and, in any event, lead to the same or similar conclusion.

8. Based on the average number of words per independent claim across approximately 158,000 utility patents issued in 2007 compared to approximately 169,000 utility patents issued in 2003.

consistent with previous years' data. Taken together, the data appears consistent with the conclusion that examiners are not granting patents with broader claims, but are granting claims of approximately the same scope or slightly narrower scope (having 6.8 more limiting words on average) than five years ago.

From all of the numerical and statistical evidence we examined above there does not appear to be support for the conclusion that the Patent Office is overwhelmed or that the quality of patent examination has declined in recent years. On the contrary, there seems to be at least some key statistical evidence suggesting that the Patent Office is operating under a growing, but more-or-less normal case load and that patent examination quality has either remained steady or has improved somewhat over the previous five years. Therefore, we reject the politically convenient but overreaching argument that patent quality has suffered as a result of an overburdened Patent Office.

B. Overly Liberal Patenting Standards

The second and probably more apt theme animating the patent quality debate is the contention that the threshold for determining patentability (the so-called 'obviousness' standard) is either too liberal or is being applied too liberally by the Patent Office and/or the courts. Low patentability standards are a fair concern. If patents are too easily obtained, adverse economic situations can arise in the form of so-called 'patent thickets'—that is, many overlapping patent rights each having only relatively modest scope, but having broad preclusive effects taken as a whole. The negative consequences of the patent thicket problem have been well documented in the academic literature.[9] Most salient among these are: i) the difficulty of clearly understanding the patent landscape because of the sheer number of patents and claims involved and the penumbra of uncertainty surrounding each claim/patent; ii) diminished ability to ascertain and estimate underlying infringement risks; and iii) extraordinarily high transaction costs necessary to consider, license and/or fight each patent in the thicket.

In the past, the Federal Circuit has constrained patent examiners to apply rigid tests in resolving complex questions of obviousness. For example, the so-called "teaching, suggestion or motivation" test required examiners to find and specifically identify a written teaching, suggestion or motivation that would lead a person skilled in the art to combine elements from the prior art (in an obvious way) before the combination could be used to support a legal obviousness rejection. These rigid tests occasionally led to anomalous results wherein, for example, persons skilled in the art could readily agree that a particular combination of prior art elements was obvious, yet an examiner could not support a legal obviousness rejection because she could not identify a written suggestion to combine the prior art references in a manner obviating the invention. In that event the Examiner, operating under previous Federal Circuit precedents, would have had no choice but to allow the claim even though she may have believed the claimed invention was obvious.

When the U.S. Supreme Court recently addressed this issue in the *KSR v. Teleflex* case,[10] the Court, in ruling the underlying patent invalid for obviousness, encouraged examiners and lower courts to look more broadly at prior art and ways in which those with ordinary skill might combine existing elements to establish obviousness of a claimed invention. The Court stated its reasoning as follows:

> "[I]f a technique has been used to improve one device, and a person of ordinary skill in the art would recognize that it would improve similar devices in the same way, using the technique is obvious unless its actual application is beyond that person's skill. A court must ask whether the improvement is more than the predictable use of prior-art elements according to their established functions."

Under KSR patent examiners are now empowered to more carefully review applications for obviousness and are not bound by rigidly applied rules for determining obviousness. It is anticipated that the KSR decision and cases following it will help examiners hold the line on obviousness and more carefully scrutinize and reject cases that previously might have been on the fringe. This, ultimately, should result in the issuance of fewer patents and stronger more enforceable patents as well as the creation of less patent thickets.

Indeed, the statistical evidence available suggests that patentability standards are sharply on the rise. Over the past eight years, utility patent allowance

9. See, e.g., C. Shapiro, *Navigating the Patent Thicket—Cross-Licenses, Patent Pools and Standard-Setting,* University of California at Berkeley (March 2001).

10. *KSR International Co. v. Teleflex, Inc.* (04-1350), U.S. Supreme Court (Decided April 30, 2007).

rates have steadily declined from a peak of 72 percent in fiscal year 2000 to about 51 percent in the fiscal year ending 2007.[11] Patent allowance rates for the first quarter of 2008 (the first post-KSR statistics available) have dropped to a new low of 44 percent.[12] Meanwhile, utility patent issuance rates have dropped 6.5 percent from a peak of about 171,000 patents in fiscal year 2003 to approximately 160,000 patents issued in 2007, even as filing rates continue to rise moderately.[13] We project issuance rates will decline another 6.8 percent (to about 149,000 patents) in fiscal year 2008 based on observed issuance rates so far in the first two quarters of 2008.

Of course, reduced patent allowance and issuance rates alone do not necessarily indicate tougher patentability standards or higher quality patents (although the data is certainly consistent with such conclusions). For one thing, it turns out that patent allowance rates are devilishly difficult to define given the common practice in the U.S. of filing multiple continuation applications attempting to patent essentially the same invention that may already have been previously rejected by the Patent Office. These and similar complications have sparked ongoing debate about how exactly to define an appropriate measure of patent allowance that accurately takes into account these additional factors.[14] Abnormally long pendency delays and a growing backlog of pending cases also complicate the issue in ways that may potentially overstate the real decline in patent allowance and issuance rates.

But there is other objective data pointing in a consistently similar direction, collectively supporting the conclusion that patents are not only getting significantly tougher to obtain, but are getting narrower in scope. For example, in the first quarter of calendar year 2008 the average per-claim word count climbed to an average of about 163.4, or about 2.1 percent higher than the same measure in 2007. The rate of increase in the average per-claim word count has also accelerated sharply from an average annualized pre-KSR growth rate of about 1.1 percent (about 1.7 additional limiting words per year, per claim) from 2003 to 2007 to a projected annualized post-KSR growth rate of about 12.5 percent (about 20.1 additional limiting words per year, per claim).[15] Armed with KSR, examiners seem to be getting increasingly tougher on applicants and are significantly reducing the scope of claims they are willing to allow.

At the same time, applicants are getting little relief from the Board of Patent Appeals, which has taken a much tougher stance on appeals from examiner rejections. Over the past eight years, the affirmance rate on ex parte appeals grew from 39.6 percent to 68.8 percent while the reversal/remand rate shrank from 57.2 percent to 29.9 percent.[16]

All of this results in a tougher, longer and more expensive prosecution road for applicants with less eventual chance of success in obtaining a patent, not to mention lower expectation for achieving a broad scope of protection even if a patent is ultimately obtained. Accordingly, we reject the argument that patentability standards are being applied more liberally by the Patent Office.

IV. The Merchant Banc Perspective

Patent quality in the merchant banking world is much less an issue of economic theory and public policy and more an issue of capital asset pricing within a specific investment context. Broadly speaking, merchant bancs are in the business of providing liquidity in otherwise illiquid markets. They typically maintain a transactional focus relative to a specific commodity or asset class in which the banc possesses particularly unique expertise. Part of the banc's unique expertise is usually the ability to inexpensively and reliably quantify and communicate information relative to the commodity or asset of interest (including, notably, quantity and quality information and corresponding value and risk expectations) in sufficient detail to enable efficient market pricing and delivery of the asset through a planned sale or other transaction. As an Intellectual Capital Merchant Banc® firm, Ocean Tomo's natural focus is providing market liquidity and related transactional

11. United States Commerce News, Press Release #07-46 (November 15, 2007). The U.S. Patent Office fiscal year runs from October 1 to September 30.

12. Comments of USPTO Director Jon Dudas testifying before the U.S. House of Representatives Committee on the Judiciary, USPTO Oversight Hearing (February 27, 2008).

13. USPTO Annual Report, Table 6 (FY 2007).

14. See, e.g., R. D. Katznelson, *Patent Continuations, Product Lifecycle Contraction and the Patent Scope Erosion.—A New Insight Into Patenting Trends*, Southern California Law Associations Intellectual Property Spring Seminar (June, 2007).

15. Based on the average annualized rate of increase in the number of words per independent claim across approximately 36,000 utility patents issued in the first quarter of calendar year 2008.

16. Board of Patent Appeals and Interferences—Receipts and Dispositions by Technology Centers for Ex Parte Appeals (FY 2002-2007) *(www.uspto.gov/web/offices/dcom/bpai/docs/recipts/fy2007.htm).*

services across a broad range of intellectual property assets, including, notably, patents.

In many ways, patent quality from a merchant banc's perspective is virtually synonymous with value. Profitable transactions drive the banking business, high-value patents drive profitable transactions, and high quality patents usually correlate to high value. It should be no surprise that the bread-and-butter activity of an intellectual capital merchant banc largely comes down to the task of identifying and separating those intellectual capital assets that have high quality and high expected value from those that do not.

But, high quality does not guarantee high value, although the concepts are closely intertwined. Statistical analysis of actual investment behavior shows that many of the underlying attributes that drive quality (e.g., claim breadth, validity and enforceability) also drive value. We found this to be true across several different markets and investment perspectives, which we have broadly categorized as follows: internal investment, external investment, private capital investment, and public capital investment. Each of these perspectives is addressed below.

A. Internal Investment

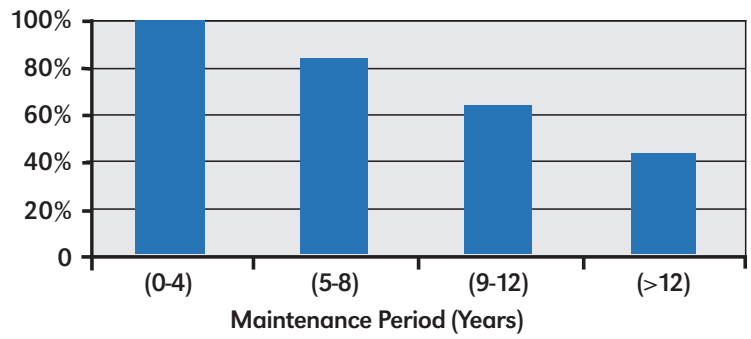
Investing in patent assets, like any investment, requires an investment thesis and carefully developed risk-reward expectations consistent with near and long-term investment objectives. Fundamental to this process is a deep understanding of the mechanisms for value creation and extraction and the primary underlying risks that create inevitable value uncertainty.

Patent investment activities focusing primarily on securing and maintaining patents on inventions and technologies developed internally to an organization are generally approached from an internal investment perspective. The investment thesis is usually a desire to increase net operating revenues through either: (i) premium pricing of patented products or services; or (ii) royalty payments or other valuable consideration (e.g., royalty credits) paid by third parties for use of the patented technology. The primary underlying risks are generally product and technology centric, which, for the most part, are fairly well understood.[17] The initial investment hurdle is overcome when expected returns exceed the cost of the required investment(s) given the underlying risks and the investment objectives.

Once a patent is obtained, unique value is derived from the legal rights it secures to the patent holder, namely the right to exclude competition in the patented technology. But not all patents have value. In fact, in the United States most patents (about 57 percent) are actually abandoned before they reach the end of their full statutory term. As in most countries U.S. patent owners are required to pay periodic maintenance fees in order to maintain the patent in force. In the U.S., maintenance fees are paid every four years and escalate progressively from $930 to maintain a patent in force beyond the fourth year to $2,360 to maintain a patent in force beyond the eighth year to $3,910 to maintain a patent in force beyond the twelfth year.[18]

The natural attrition effect of the maintenance fee system is to discourage renewal of less valuable, lower-quality patents by placing substantial recurring costs on all patents. This trend is borne out in Figure 1, below, which indicates average patent maintenance rates for a population of about 71,000 U.S. utility patents issued in 1986.

Figure 1. Patent Maintenance Rates (1986)



As the above graph illustrates, approximately 83.5 percent of all utility patents issued in 1986 were maintained beyond the 4th year, approximately 61.9 percent of the patents were maintained beyond the 8th year and only approximately 42.5 percent of the patents were maintained beyond the 12th year.

17. This will vary widely of course depending on the stage of the investment, the nature of the underlying technology and maturity of the relevant markets.

18. USPTO Current Fee Schedule, 37 CFR §§ 1.20 (e)—(g).

In other words, all but about 42.5 percent of the original sample population was eventually abandoned before the full statutory patent term.

Significant value insights can be gleaned from analyzing past renewal decisions of patent owners within the framework of an internal investment exercise.[19] From an internal investment perspective, maintenance fees create a recurring investment hurdle that not all patents can overcome based on the owners' own internally-generated value and risk expectations. Patent owners are uniquely knowledgeable and well-qualified to make internal patent value and risk assessments of their own patent holdings, and they are economically and financially motivated to make accurate judgments and sound investment decisions based thereon. By specifically examining the characteristics of patents that were previously renewed versus those that were previously abandoned, one can begin to build informative models that can help make predictive assessments about the quality and likely value of current in-force patents.[20]

For example, at Ocean Tomo powerful computer models leveraging massive data sets produce a broad range of statistically informative ratings and correlated value metrics for patents based on identical input criteria and uniformly applied ratings algorithms. These ratings and other associated metrics are routinely used as part of the intake screening process to help quickly identify and assess value and risk expectations for incoming patents and portfolios. The models essentially predict patent maintenance and abandonment events by comparatively scoring individual patent assets based on various identified metrics (predictor variables) determined to have a statistically significant correlation to observed patent maintenance rates.[21] Raw scores represent the simple probability that any given patent would be maintained for the full statutory term. Quantitative value and risk expectations stem from the simple observation that valuable patents tend to be maintained over time while worthless patents tend to be abandoned.

What is quite interesting, albeit not particularly surprising, is that many of the individual metrics identified as statistically predictive of patent renewal rates are also intuitively important from a patent quality perspective. In sample after sample, we find that higher patent maintenance rates are significantly correlated to the following: a larger number of independent and dependent claims; a smaller number of words per independent claim; a smaller number of different words per independent claim; longer written specifications; higher forward citation rates (both raw and age normalized); a larger number of backward citations; and a larger number of related patent family members (both domestic and international). More importantly, at least from a merchant banc's perspective, the calculated maintenance probabilities are significantly correlated to other observed patent value measures, such as commercialization rates, licensing rates, and litigation rates.

All of the available statistical and numerical analysis indicates that the probability of patent maintenance (calculated using any number of available predictive metrics and models) is a relatively good indicator of patent quality and value.

B. External Investment

Patent investment activities focusing primarily on acquiring patents on inventions and technologies developed by others outside of an organization are generally approached from an external investment perspective. The investment thesis in this case is usually a desire to reduce operating risks by acquiring patent assets that could otherwise potentially be asserted against an organization. Alternatively, the investment thesis may be a speculative desire to acquire patent assets at an attractive price and monetize them (either through a sale event, licensing transactions or legal enforcement) in a way that effectively realizes a higher price. The primary underlying risks in the external investment context are generally legal in nature, which are often fairly complex and not always well understood. Analysis of complicated external risk factors can often spiral out of control making patent acquisition transactions particularly difficult to complete.

Actual market data on patent sale transactions has been historically very limited and difficult to obtain as the volume of successful transactions has been low and pricing data is often kept confidential. However, starting in 2006 Ocean Tomo launched its live patent auctions, creating for the first time real market data and full price discovery on hundreds

19. See, K. Moore, "Worthless Patents" (July 2004). George Mason Law & Economics Research Paper No. 04-29. (observing that "[r]enewal rate data [is] a better predictor of value than litigation data as renewal rate data captures the many ways a patent may be of private value to its owner such as revenue generation via licensing or litigation, defensively, or for signaling purposes.")

20. J. Barney, "A Study of Patent Mortality Rates: Using Statistical Survival Analysis to Rate and Value Patent Assets," *AIPLA Quarterly Journal*, 30, no. 3, pp. 317—352 (2002).

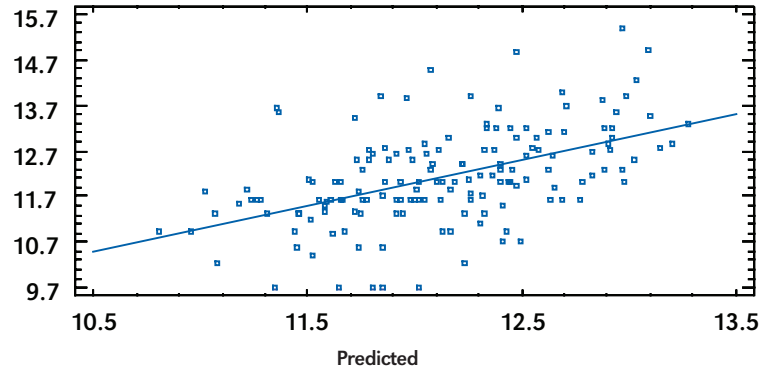
21. For model construct and regression details see, J. Barney, "Method and system for rating patents and other intangible assets" (U.S. Pat. 6,556,992).

of patent sale transactions occurring annually. Statistically analyzing this market pricing data relative to underlying patent quality metrics yields a wealth of new information, further revealing how markets actually value patents and further confirming the underlying quality metrics.

We began our study by collecting all of the underlying data on 185 lots of patents sold to date through the Ocean Tomo auctions.[22] To keep the analysis simple, we only included lots that contained at least one issued U.S. utility patent, and we ignored the presence or absence of any additional pending applications or international counterpart patents or applications. We excluded one lot with a sale price of $6.6 million as a statistical outlier. Additionally, since the current auction format does not allow lots to be sold for less than $15,000, we excluded 15 lots previously sold at prices below this level in order to avoid possible pricing bias. The final data set consisted of 169 lots representing 384 issued U.S. utility patents and roughly $53 million in auction sales.

We next constructed a simple log regression pricing model using previously calculated renewal probabilities for each patent averaged across each lot.[23] Interestingly, this single factor had the largest impact of all the factors tested, accounting for just over 15 percent of the total variance in actual realized sale prices. Adding forward citation information and normalizing for patent age increased model predictiveness to just over 23 percent. Adding technology obsolescence rates increased model predictiveness to 26 percent.[24] The chart below shows the actual correlation between observed and predicted prices for each lot according to this simple pricing model.

Figure 2. Plot Of Log (Price)



In this case, the market data tells us that the probability of patent maintenance is again a relatively good indicator of patent quality and value. The data also tells us that forward citation rates and obsolescence rates[25] are also good indicators of quality and value particularly when combined with the probability of maintenance.

C. Private Capital

In thinking about the importance of patents within private capital markets, an apparent question is—what percentage of venture capital transactions involve patents or patent applications at the time of their investment (or within a year)? Before we performed research on this question, we thought the answer would be in the range of 90 percent. We imagined such a high percentage because venture capitalists are really smart people and the companies (e.g., Kliner Perkins, Sierra, Sequoia, and Accel) include the best-of-the-best. We performed our research based on a sample data set collected between 1995 and 2002 representing about 150 venture capital transactions. The results are presented in Figure 3.

As it turns out, we were wrong—only about 25 percent of the start-ups we surveyed had filed patent applications within one year of funding. This led us to ponder an additional question, "Does it make any difference?" While the companies involved would

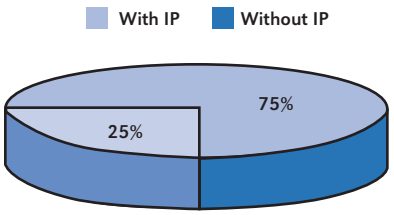
22. Ocean Tomo auction data, including sale price information and specific patent numbers for each lot sold, is publicly available through press releases issued by Ocean Tomo within several days following each auction event.

23. Renewal probabilities were calculated for each patent within several months prior to each auction in generally the same manner as described above. Calculated renewal probabilities were averaged across each lot and then transformed to a log equivalent using an inverse-normal probability transform.

24. The exact model construct in this case was as follows: Log(Price) = 10.1523 + 0.600071*Invnormal(M4,0,1) + 0.276884*Log((Fwd_Cites+1)/AgeFrmIssued) + 3.6181*(ObsRate), where M4 is the implicit probability of renewal at year 4.

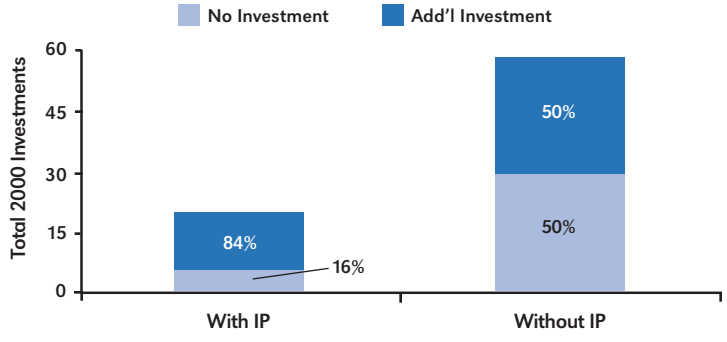
25. Obsolescence rates can be calculated as the coefficient of exponential decay of citations over time. High obsolescence rates are typically associated with fast moving (and apparently more valuable) technologies such as wireless communications and computer electronics.

Figure 3. 2000 Venture Capital Investments By Type



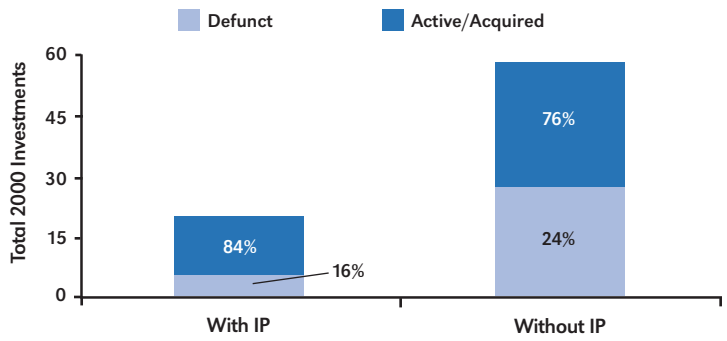
not share with us their financial data, two interesting items of data were available to help answer our question: (1) which companies received additional rounds of capital, and (2) which companies ultimately went bankrupt. The results of our analyses are summarized in the following two figures.

Figure 4. 2000 Venture Capital Investments With Additional Funding



The left side data indicate that if a company had patents, it got a second round of capital 84 percent of the time. If a company did not have patents, it got a second round of funding only 50 percent of the time. Is that a notable difference? We think so.

Figure 5. 2000 Venture Capital Investments By Status



What about bankruptcy? The above results indicate that those companies that had patents went bankrupt only 16 percent of the time, whereas those without patents went bankrupt 24 percent of the time. Again, in our view, this is a notable difference.

A fair conclusion to be drawn from the above analyses is that the private capital marketplace recognizes real value associated with patent assets and rewards those companies that are successful in creating or securing these assets.

D. Public Capital

Looking to the public equities market we again asked the question, "Do quality patent assets matter?" To answer this question and further confirm our own statistical measures of patent quality, we undertook a detailed study to determine which publicly traded companies owned the most valuable / highest quality patents and we examined their performance as compared to firms with lesser quality patents or no patents at all. Since we hypothesize that quality patents make a positive difference in the marketplace, if our measure of patent quality was accurate, the companies with the best patents should perform better.

To begin our research, we identified and mapped nearly 600,000 U.S. utility patents owned by more than 4,200 listed companies. We then used a statistical regression model to calculate abandonment probabilities for each individual patent at quarterly intervals over a ten-year period. Abandonment probabilities were transformed into linear value scalars using a lognormal transform function.[26] These value scalars were depreciated both linearly and exponentially by patent age to account for patent term depletion and technology obsolescence. Adjusted value scalars were then aggregated by company to produce an objective, statistically determined measure of cumulative expected value for patent portfolios owned by each of the listed

26. This step is necessary for value aggregation purposes since maintenance probabilities are not necessarily (and, in fact, we now know they are not) linearly correlated to value. The transform function we used in this case was a simple cumulative lognormal probability distribution function. The transform produced a unique linearized metric we call OTMV or "Ocean Tomo Maintenance Value" for each patent at each quarterly interval in time.

companies on a quarterly basis over the ten-year-study period.

Ned Davis Research (NDR) was engaged to analyze the resulting data set.[27] NDR's analytical approach was to apply a regression analysis to ten years of financial data spanning 1995-2005 in order to identify measurable factors that generally predict stock market returns. To do this, NDR first removed sector bias from the data results by normalizing the expected patent value for each company by the relevant sector mean and standard deviation of patent value, and also created sector-normalized data for book/price, market capitalization, and beta. These several key factors typically explain most market returns through time and thus it is important to normalize against them.

Using properly normalized data and applying its own statistical expertise and analytical tools NDR confirmed that the statistical measure of cumulative patent value we developed was indeed significantly correlated to observed market returns over the ten- year-study period. Specifically, NDR determined that using investment selection criteria calculated as the simple ratio of the cumulative expected patent value divided by book value produced statistically significant excess returns over time. For the first time in financial history, we observe that quality patents do impact stock price. More specifically, NDR reported that, on average, a 10 percent increase in the ratio of a company's expected patent value to book value leads to an expected 7 percent increase in its stock price.

On September 13, 2006, Ocean Tomo launched the Ocean Tomo 300® Patent Index—the first equity index of its kind based on the assessed value of corporate intellectual property.[28] The Index represents a diversified portfolio of 300 companies that we believe (according to our models) own the highest quality, most valuable patents as normalized to book value. The Index selection methodology specifically identifies the six top companies within each of 50 defined groups of size and style (e.g., value, relative value, blend, growth at a reasonable price, and growth by decile). The Index reconstitution, which is performed annually, is roughly summarized as follows.

1. Potential Index constituents are the 1,000 most liquid equities trading on major U.S. exchanges.
2. The potential Index constituents are then narrowed to those that own patents.
3. The remaining companies are then divided into 50 size and style groups and assigned patent value to book value ratios using proprietary statistical models.
4. The stocks in each group are ranked using a 100 percent rules-based methodology that identifies those stocks that offer the greatest patent portfolio values while maintaining broad-based diversification.
5. The six highest ranking stocks in each group are included in the Index, resulting in a total of 300 stocks. These are weighted by market capitalization.

Through the end of the first quarter of 2008, the Ocean Tomo 300 Patent Index outperformed the S&P 500 by more than 9 percent with similar risk characteristics. For the ten-year period ending October 31, 2006, the Index (historically reconstructed by NDR) outperformed the S&P by an annualized rate of more than 2 percent, again with similar risk characteristics.

Table 2. Ocean Tomo 300 Patent Index

Risk-Return Table	Return (%)	Std Deve. (%)	Beta vs. S&P 500	Alpha vs. S&P 500 (%)	Sharpe Ratio
Ocean Tomo 300 Patent Index	11.76	16.96	1.0	3.0	0.48
Dow Jones Industrial Average	9.29	15.75	0.9	1.2	0.36
NASDAQ Composite	7.55	28.76	1.5	-2.7	0.13
S&P 500	8.64	15.52	1.0	0.0	0.32

27. NDR is an expert in quantitative market analysis, leveraging one of the most comprehensive research product offerings available and having a large institutional following in the securities industry.

28. The American Stock Exchange recognized the Ocean Tomo 300® Patent Index as "the first major, broad-based market equity index to be launched in 35 years, and follows the progression from the Dow Jones Industrial Average in 1896, to the Standard & Poor's 500 in 1957 and then to the NASDAQ Composite Index in 1971."

NDR summarized the historical performance of the Index as follows:[29]

While we are, of course, pleased with these financial performance results, the real point of impact is the broader implications on how public markets view and appreciate valuable patent assets. From that perspective, the Ocean Tomo 300 Patent Index is a truly unique affirmation that patent quality can be measured and that quality patents matter.

V. Conclusion

Patent quality, as it turns out, exists not only in the eye of the beholder, but can be objectively measured in several statistically meaningful ways. Based on these statistical quality measurements, we believe the U.S. Patent Office is doing a good job currently and that patent quality is as high if not higher now as it was five years ago. Patent quality is also being recognized and rewarded in existing and emerging markets for intellectual property transfer and in the broader capital markets. Thankfully, for those of us in the profession, we are beginning to see data—already there—confirming what we believed all along. Patent quality can be measured; it is improving; and it makes a difference. ■

Based on a Paper Presented to the Colloquium on a Comprehensive Approach to Patent Quality.

Federation Internationale des Conseils en Propriete Industrielle. Amsterdam, June 8-9, 2007.

29. Based on back-testing analysis conducted by NDR. Historical performance results are provided for informational purposes only. This is not a solicitation to invest.